CHARACTERIZATION OF A WIPE SAMPLE FROM MANITOWOC PUBLIC UTILITIES

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Executive Summary

Manitowoc Public Utilities (MPU) submitted one wipe sample of material collected from the porch of a nearby residence for analysis. The goal of the work was to analyze the composition of the black material collected on the wipe samples in order to determine its origin. The possibilities of what this material is include: dirt and/or sand, coal, petroleum coke, and CFB boiler ash.

Sections of the sample containing the material in question were cut from the paper towel, dried, and mounted using double-stick carbon tape to a graphite planchet for scanning electron microscopy (SEM) analysis. Morphological analysis was performed on the wipe sample. Morphological analysis consists of obtaining images and chemical compositions of regions of interest.

The results of the analyses indicate that the most abundant materials found appear to be limestone and dolomite derived particles and some quartz particles. Numerous dark particles are present that are carbon based and contain sulfur indicating the likelihood of them being coal or char particles.

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INTRODUCTION

Manitowoc Public Utilities (MPU) submitted one wipe sample of material collected from the porch of a nearby residence for analysis. The goal of the work was to analyze the composition of the black material collected on the wipe samples in order to determine its origin. The possibilities of what this material is include: dirt and/or sand, coal, petroleum coke, and CFB boiler ash. The sample is listed in Table 1.

Table 1. Samples submitted and analyses requested.

MTI Sample	Description	Analyses Requested
14-321	Wipe Sample 5/23-14	Morphology

METHODS

The wipe sample submitted was a paper towel containing dark (black) material embedded on the towel. No loose or removable material was present. Sections of the sample containing the material in question were cut from the paper towel, dried, and mounted using double-stick carbon tape to a graphite planchet for scanning electron microscopy (SEM) analysis. The mounted sample was coated with carbon for improved conductivity in the SEM. Morphological analysis was performed on the wipe sample. Morphological analysis consists of obtaining images and chemical compositions of regions of interest. Images are taken using backscattered electron imaging, in which the brightness of a material is related to its average atomic number – higher atomic number materials such as iron appear brighter than lower atomic number materials such as silicates.

RESULTS AND DISCUSSION

The results of the morphological analysis for the Wipe Sample 523/14 (MTI 14-321) are presented in Table 2, with corresponding backscattered electron images presented in Figures 1 and 2. Several of the analysis spectra (those indicated) contained a large peak due to carbon. This carbon peak is not suitable for quantitation, but indicates the presence of carbon and/or organic material. The probing analysis of these carbon based particles indicated the presence of sulfur with lesser amounts of aluminum, silicon, and sometimes calcium. In general, a coal particle would show the presence sulfur in this type of analysis. Analysis points 1, 3, and 8 in Figure 1 and points 7 and 8 in Figure 2 consisted mainly of calcium and magnesium or just calcium. These compositions are consistent with limestone and/or dolomite material. Particles 2 and 5 in Figure 1 contain mainly silicon and would be consistent with a quartz particle. The bright particle in Figure 1 was mainly iron. Particle 9 in Figure 1 and particle 6 in Figure 2 contained aluminum, silicon and potassium and would be consistent with the clay mineral illite. The origin of the illite could be from clay dust, but it is also known to be present in the mineral matter of some coals as is quartz. The dark fibrous appearing structures are the paper towel fibers.

What would generally be expected is if the material on the wipe came from dirt or sand, a predominance of silicon based mineral grains would be expected. If the materials have a petroleum coke origin, then one would expect to find vanadium and nickel present. Coal or char

particles would show a large carbon peak with the presence of sulfur. The most abundant materials found appear to be limestone and dolomite derived particles and some quartz particles. Numerous dark particles are present that are carbon based and contain sulfur indicating the likelihood of them being coal or char particles.

Table 2. Morphological analysis results for Wipe Sample 5/23/14 (MTI 14-321). Results expressed as weight percent on an elemental basis, normalized to 100%.

Fig.	Point	Description	Na	Mg	Al	Si	P	S	K	Ca	Fe	O
1	1	Particle	1.9	18.9	1.3	0.2	0.0	0.0	0.3	18.9	0.1	58.5
	2*	Dark particle	0.0	0.4	2.2	1.6	0.8	39.4	0.3	0.9	0.9	53.5
	3*	Dark particle	1.1	0.3	0.9	0.5	1.0	35.6	0.1	0.7	0.0	59.8
	4	Particle	1.6	16.3	1.7	0.7	0.2	0.0	0.6	25.3	1.0	52.6
	5	Bright particle	0.5	0.4	2.5	5.8	0.8	1.9	0.3	3.0	70.1	14.6
	6*	Dark particle	0.0	0.6	3.7	1.2	0.6	27.1	0.0	1.3	1.3	64.3
	7*	Dark particle	1.8	0.8	2.9	0.7	0.0	28.1	0.2	0.5	1.1	63.9
	8	Particle	1.2	15.2	1.3	0.4	0.0	0.1	0.5	15.3	0.0	66.0
	9	Particle	0.8	0.6	11.5	20.7	1.7	0.0	11.6	0.0	0.2	52.9
2	1*	Dark particle	2.9	2.3	3.0	2.9	4.3	36.2	2.2	3.8	1.1	41.4
	2	Particle	0.1	0.0	2.4	40.9	0.7	0.0	0.0	0.1	0.0	55.8
	3*	Dark particle	1.1	3.4	4.2	3.3	1.3	16.0	0.7	2.1	1.3	66.7
	4*	Dark particle	0.0	1.3	4.7	2.3	0.7	16.1	0.2	1.1	1.5	72.1
	5	Particle	0.0	0.0	2.8	45.6	0.7	0.2	0.0	0.1	1.0	49.6
	6	Particle	0.9	0.4	13.0	21.5	1.6	0.0	11.1	0.0	0.3	51.3
	7	Particle	1.4	16.6	2.6	1.2	0.2	0.1	0.4	13.7	0.4	63.5
	8	Particle	0.1	1.7	2.1	0.9	0.3	0.1	0.1	27.1	0.9	66.8
	Average	**All points**	**0.90**	**4.65**	**3.69**	**8.84**	**0.87**	**11.81**	**1.68**	**6.70**	**4.78**	**56.07**

*Spectra contained a large or significant carbon peak which was not quantified.

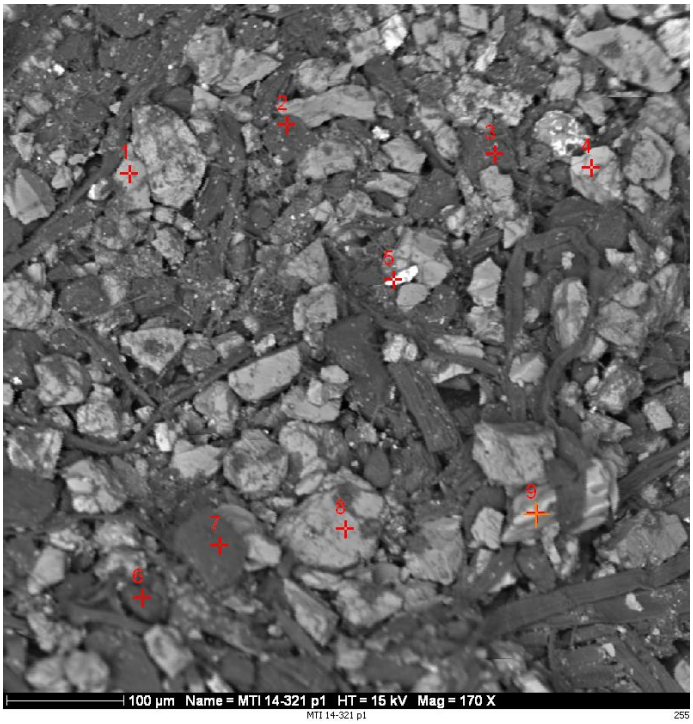

Figure 1. Backscattered electron image of Wipe Sample 5/23/14 (MTI 14-321), showing analysis points 1 through 9.

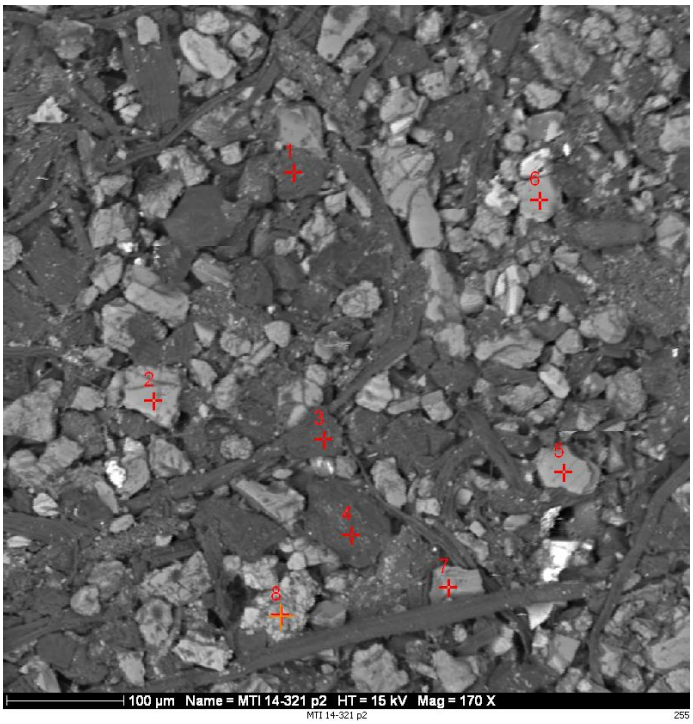

Figure 2. Backscattered electron image of Wipe Sample 5/23/14 (MTI 14-321), showing analysis points 1 through 8.

SUMMARY

Morphological analysis was performed on the each of the wipe samples. Morphological analysis consists of obtaining images and chemical compositions of regions of interest.

The results of the analyses indicate that the most abundant materials found appear to be limestone and dolomite derived particles and some quartz particles. Numerous dark particles are present that are carbon based and contain sulfur indicating the likelihood of them being coal or char particles.